

CLAIMS

1. A material handling tool, comprising:
a tool body;
a plurality of needles mounted to the tool body, each of the plurality of needles
5 constructed and arranged to remove material from a work area and deposit material on a
work area;
a plurality of plungers moveable in the tool body, each of the plurality of
plungers associated with a corresponding one of the plurality of needles, wherein each of
the plungers has a passageway that allows fluid flow through the plunger; and
10 a controller constructed and arranged to individually address each of the
passageways so that flow in each of the passageways is individually controlled.
2. The tool of claim 1, wherein the controller comprises a plurality of
actuators, each of the actuators capable of opening and closing a corresponding
15 passageway.
3. The tool of claim 2, wherein each of the plurality of actuators includes a
membrane valve that controls fluid flow with respect to a corresponding passageway.
- 20 4. The tool of claim 2, wherein the controller comprises a plurality of control
switches that provides signals to the plurality of actuators to open and close a
corresponding passageway.
5. The tool of claim 4, wherein each of the plurality of control switches
25 comprises a valve that provides a fluid signal to a corresponding actuator.
6. The tool of claim 2, wherein the controller comprises a plurality of drive
switches that controls flow through a passageway opened by an actuator.
- 30 7. The tool of claim 6, wherein each of the plurality of drive switches
includes a valve that provides a fluid flow for a corresponding passageway.

8. The tool of claim 1, wherein closing of a passageway of a plunger results in one of drawing fluid into and expelling fluid from a corresponding needle when the plunger is moved in the tool body.

5 9. The tool of claim 1, wherein one portion of each plunger is secured to a first portion of the tool body and a second portion of each plunger is slidably engaged with a channel in a second portion of the tool body such that movement of the first portion of the tool body relative to the second portion of the tool body causes a pressure change in each channel for plungers that have their passageway closed.

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10. A robotically manipulable material handling tool, comprising:
a tool body;
a first number of needles mounted to the tool body, each of the needles constructed and arranged to remove material from a work area and deposit material on a
15 work area;
a plurality of plungers moveable in the tool body, each of the plurality of plungers associated with a corresponding one of the plurality of needles, wherein each of the plungers has a passageway that allows fluid flow through the plunger;
a first number of membrane valves, each valve associated with a corresponding
20 plunger and controlling flow for the passageway in the plunger; and
a valve controller constructed and arranged to control each of the membrane valves by providing signals to the membrane valves;
wherein the valve controller is adapted to control the membrane valves to individually control flow for each passageway.

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11. The tool of claim 10, wherein the valve controller includes a plurality of first valves that each provide an air pressure signal to a corresponding group of membrane valves to control the membrane valves between open and closed states to open and close a corresponding passageway.

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12. The tool of claim 11, wherein the valve controller includes a plurality of second valves that each provide a fluid flow to corresponding membrane valves.

13. The tool of claim 10, wherein the plurality of needles and corresponding membrane valves are arranged in an M x N array.

5 14. The tool of claim 13, wherein the valve controller includes M valves that each provide an air pressure signal to membrane valves in a corresponding row.

15. The tool of claim 13, wherein the valve controller includes N valves that each provide a fluid flow to membrane valves in a corresponding column.

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16. The tool of claim 13, wherein closing of a passageway of a plunger results in one of drawing fluid into and expelling fluid from a corresponding needle when the plunger is moved in the tool body.

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17. The tool of claim 13, wherein the valve controller is mounted to the tool body.

18. The tool of claim 10, wherein the valve controller is adapted to control the membrane valves to simultaneously control flow for a plurality of passageways.

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19. A robotically manipulable material handling tool, comprising:
a tool body;

a plurality of needles mounted to the tool body in M columns and N rows, each of the needles constructed and arranged to remove material from a work area and deposit

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material on a work area;

a plurality of plungers moveable in the tool body, each of the plurality of plungers associated with a corresponding one of the plurality of needles, wherein each of the plungers has a passageway that allows fluid flow through the plunger;

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a plurality of addressing valves, at least one addressing valve associated with a corresponding passageway and controlling flow for the passageway; and

a plurality of switches that provide signals to the addressing valves, the number of switches equal to M + N;

wherein the plurality of switches are adapted to provide signals to the addressing valves to individually control flow for each needle.

20. The tool of claim 19, wherein the plurality of switches are mounted to the
5 tool body.

21. The tool of claim 19, wherein the plurality of switches includes M
switches associated with M columns of needles, each of the M switches corresponding to
and providing signals to valves for a corresponding column, and the plurality of switches
10 further includes N switches associated with N rows of needles, each of the N switches
corresponding to and providing signals to valves for a corresponding row.

22. The tool of claim 21, wherein the plurality of switches include fluid
valves that provide at least one of a fluid pressure and a fluid flow to corresponding
15 addressing valves.

23. The tool of claim 19, wherein the plurality of switches are adapted to
provide signals to the addressing valves to simultaneously control flow for a plurality of
needles.

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